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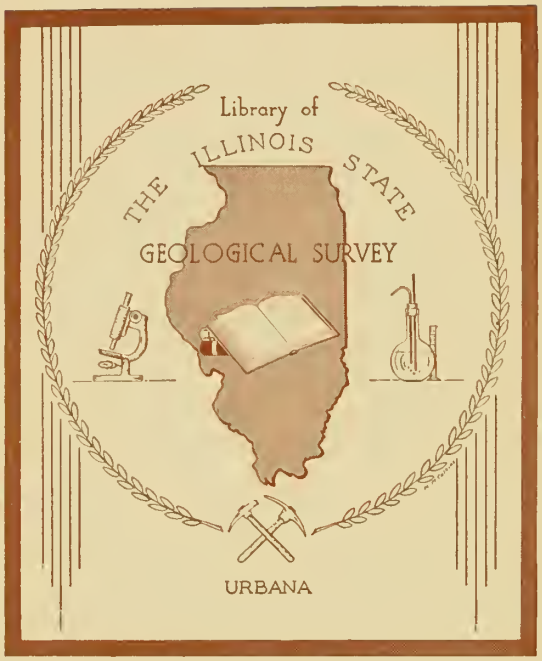

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(60041—750—2-44)

THE PENNSYLVANIAN STRATIGRAPHY OF THE CARLINVILLE, ILLINOIS, QUADRANGLE

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The northeast corner of the Carlinville quadrangle is at the intersection of 89° 45′ west longitude and 39° 30′ north latitude. This intersection is about one-half mile east of Virden and 20 miles south of Springfield.

Sedimentary rocks of Late Pennsylvanian age crop out in two general regions in the quadrangle. One region is in North Palmyra and South Palmyra townships and extends along Massa Creek and its tributaries nearly the length of the two townships. The other region of outcrops is in the vicinity of Carlinville, near the southern margin of the quadrangle, along Macoupin Creek and its tributaries.

THE CYCLOTHEMS OF THE QUADRANGLE

A number of cyclothems comprise the late Pennsylvanian (McLeansboro) rocks. Typically each cyclothem includes a coal and a marine limestone, but in this quadrangle the coals do not attain a conspicuous thickness, whereas the limestone is represented in all but one cyclothem.

When this quadrangle was mapped geologically in 1930-31 and the manuscript report written, the following cyclothems were recognized.

Cyclothem	*Approximate thickness*
Divide	9 feet
Upper LaSalle (now Upper Livingston)	16 "
Lower LaSalle (now Lower Livingston)	16-17 "
Upper Macoupin	7-12 "
Lower Macoupin	15-23 "
Centralia (Flannigan?)	5 feet
Shoal Creek	35 "
Trivoli (exposed)	34 "

Cyclothem exposures vary so greatly in thickness from place to place in the quadrangle that the above figures are but fair approximations of average thickness. In a recent recapitulation of cyclothem terms,[1] the Collinsville cyclothem occurs between the Trivoli and Shoal Creek cyclothems. At the time of completion of field work in this quadrangle, however, the Collinsville cyclothem had not been recognized in the vicinity.

CARLINVILLE PENNSYLVANIAN STRATIGRAPHY

Trivoli cyclothem.—The full thickness of this cyclothem is probably not exposed in the quadrangle. Neither is the limestone present in the exposures, as it is in each of the other cyclothems. The cyclothem includes No. 8 coal, and in the dark shale above the coal *Lingula carbonaria* Shumard is abundant. Still higher in shale characterized by close-set joint planes is a species of *Aviculopecten* in considerable numbers.

Shoal Creek cyclothem.—This cyclothem is characterized by the absence of coal and by the presence of the most conspicuous limestone in the quadrangle, which has been called both Shoal Creek and Carlinville.[2] In the Carlinville and adjacent quadrangles, the name "Carlinville" is convenient and logical and in his studies in the quadrangle the author used the name "Shoal Creek" for the highest limestone in the quadrangle, mainly be-

[1]Weller, J. Marvin, Rhythms in Upper Pennsylvanian cyclothems: Trans. Ill. State Acad. Sci., Vol. 35, pp. 145–146, 1942.

[2]Payne, J. N., Structure of Herrin (No. 6) coal bed in Macoupin County, etc., Illinois: Illinois Geol. Survey Cir. 88, p. 5, 1942.

Ekblaw, Sidney, The question of the Shoal Creek and Carlinville limestones: Trans. Ill. State Acad. Sci. Vol. 25, pp. 143–45, 1932.

Worthen, A. H., Geology and Paleontology: Geol. Survey of Ill. Vol. VI, p. 3, 1875.

Weller, Stuart, The Geological Map of Illinois: Illinois Geol. Survey Bull. 1, p. 21, 1906.

Udden, J. A., Notes on the Shoal Creek limestone: Illinois Geol. Survey Bull. 8, pp. 118–119, 125, 1907.

cause an outcrop on an unnamed tributary to the West Fork of Shoal Creek in the outskirts of Litchfield contained numerous imbricated limestone fragments identified as belonging to that limestone.

The characteristic lithologic aspects of the lower limestone (the Shoal Creek) in this and nearby quadrangles are invariable. It ranges from 6 to 8 feet in thickness, and a shale parting, commonly about 8 inches thick, separates a lower foot of limestone from that above. Possibly this feature was not so obvious to the early investigators who saw the naturally weathered outcrops, before quarries fully exposed the somewhat massive aspects of the more recently modified faces. It varies from dark gray to almost black in some exposures, and its surface weathering color is a dark yellowish-brown. Its lower member commonly is even darker in color, is finely crystalline, and is frequently marked by widely diverging, more or less individually branching traces or imprints, possibly suggestive of a plant impression or of some crawling organism.

Fossils.—Fusulines have been included in the tentative list of fossils which has been written down for the quadrangle. However, Dunbar and Henbest have not noted them in the Shoal Creek,[7] so to include them in the fossil list is possibly an error. Very common Pennsylvanian fossils have been secured from the limestone, but never in great abundance. The list follows: *Marginifera splendens, Neospirifer cameratus, Composita subtilita, Polypora* sp., *Astartella vera, Schizostoma cateloides, Naticopsis altonensis, N. torta,* and *Phillipsia* sp.

In the exposures in the northwest part of the quadrangle, in shales interbedded with the thinner limestones, species other than those in the above list have been found. Additional micro-organisms probably will be discovered. The following have been recognized: *Ammodiscus incertus,* species of *Tetratraxis* and *Tuberitina, Lingula carbonaria, Trigonoglossa nebracensis, Orbiculoidea missourensis; Euphemus carbonarius, Trepospira illinoisensis, T. sphaerulata, Nuculopsis ventricosa, Sphaerodoma primogenia* cf.

Centralia cyclothem.—The Centralia (Flannigan ?) cyclothem is not fully developed in the quadrangle. The coal and underclay are not represented. Where its limestone is in fullest development there are but few other lamina which seem properly to belong in this cyclothem. A maximum exposure of about 15 feet, in the east outskirts of Carlinville, is mostly sandstone and sandy shale with but little limestone. Some of this sandstone has the aspects of a channel sandstone.

Its limestone, however, is distinguished by the many fossil specimens it carries. Udden[8] has a long list of species. From another outcrop than the one mentioned by Udden, Dr. Needham has made an extensive collection. Because of the brittle resistant nature of the reddish crystalline rock, perfect specimens are rarely obtained. Superficially the *Productid* element in its fauna makes it distinctive, but the rock probably contains many more forms of *Composita* than it does *Productids.* Prominent among the many exceedingly variable forms of *Composita* apparently is *C. trilobata* Dunbar and Condra. Probably *C. elongata* Dunbar and Condra also is present, its condition of preservation such that it frequently gives the impression that it is *Dielasma.*

Other fossils are: *Chonetes granulifer, Linoproductus prattenianus, Juresania nebrascensis, Composita subtilita,* probably other varieties of *Composita, Aviculopecten occidentalis,* and questionable species of *Myalina* ? and *Loxonema* ?. Stratigraphically, this exceedingly fossiliferous limestone is about 17 feet above the Shoal Creek limestone.

Macoupin cyclothem.—Wanless first published the name Macoupin[9] without stating its derivation. From the abundant number of exposures of the limestone with its associated No. 9 coal on Macoupin Creek in the Carlinville quadrangle, the author in his field studies began to dub the limestone the "Macoupin." The cyclical application was first formulated by Dr. Wanless.

Of the several cyclothems in the quadrangle, the Macoupin probably is the best and most typically developed in a single exposure, in a short gully tributary to

[7]Dunbar, C. O., and Henbest, L. G., Pennsylvanian Fusulinidae of Illinois: Illinois Geol. Survey Bull. 67, pp. 13, 16, 1942.

[8]Op. cit., page 120. The "old Walker farm," the "Kirchoff farm," later.

[9]Wanless, H. R., Pennsylvanian section in Western Illinois: Bull. Geol. Soc. America Vol. 47, pp. 811-812, 1931.

Macoupin Creek, just north of Highway 4 and east of the crossing made by that highway over Macoupin Creek, in the NW. ¼ sec. 2, T. 9 N., R. 7 W., and sec. 35, T. 10 N., R. 7 W.

In addition to its display of the best developed coal in the quadrangle, the Macoupin cyclothem carries also a well-developed underclay. In this exposure the underclay is more than 8 feet thick, is structureless and bluish-gray, is calcareous except in the upper 9 or 10 inches, contains small calcareous concretions, and has minute crystals of pyrite and marcasite.

Although satisfactorily developed in this part of the quadrangle, farther north along Macoupin Creek perplexities of stratigraphy occur. The variations always occur below the recognized Macoupin limestone and include one or more thin fossiliferous limestones. One of the limestones has been said to be a "fresh-water" limestone and the other has been assumed to be the Centralia, although its texture, color, and fossil content are different. Possibly rudimentary fragments of other cyclothems than those recognized in this paper are present.

Fossils.—The fauna is marked by the presence of corals, crinoids, and gastropods which are practically absent from the Centralia limestone. J. Marvin Weller has recognized a large fauna in the field exposures and has given his tentative identifications to the author. The list includes: *Lophophyllum profundum, Orbiculoidea missouriensis, Rhombpora lepidodendroides, Marginifera splendens, Chonetes granulifer, Neospirifer cameratus, Ambocoelia planoconvexa, Leda bellistriata, Myalina swallowi, Phanerotrema grayvillensis, Schizostoma catelloides, Pseudorthoceras knoxense, Punctospirifer kentuckyensis,* and various species of *Myalina, Astartella,* and *Metacoceras.*

Upper Macoupin cyclothem.—This cyclothem, a rudimentary cyclothem according to Dr. Weller, is a series of interbedded limestones and shales, possibly only the marine segment of the cyclothem. In its best exposure it aggregates a little less than 8 feet. The two most prominent limestones in the cyclothem range from bluish-gray to purplish in color, both hard and resistant, the lower of the two sparingly fossiliferous. The higher limestone, here called the Upper Macoupin limestone, ranges up to about 4½ feet in thickness, is marked by a *Productid* fauna, and is fossiliferous.

Fossils.—Its fossils include: *Derbya crassa, Pustula pustulosa, Neospirifer cameratus, Linoproductus prattenianus, Punctospirifer kentuckyensis, Ambococlia planoconvexa,* and *Composita subtilita.*

Lower Livingston cyclothem.—The limestone of the Upper Livingston cyclothem has been called the "LaSalle" limestone by the author in a previously published abstract.[10] In this usage, he was following a correlation suggested by Sidney Ekblaw.[11] Later usage, however, has substituted Livingston, Upper and Lower, for "LaSalle." Independently the author has been impressed by the general correspondence of the LaSalle with the Carlinville quadrangle Livingston, lithologically and faunistically, so that he favored Ekblaw's suggestion.

The conditions of sedimentation for the Livingston cyclothems make it somewhat difficult to discuss the Lower Livingston without constant reference to the Upper Livingston. The most noteworthy fact about the Lower Livingston in this quadrangle is that the marine limestone horizon is a locus of 8 thin limestone strata, ranging from one-half to 2 inches in thickness, and separated by fossiliferous shales up to 9 inches in thickness. Below these strata is a recognizable coal horizon with a little more than 4 feet of clay which may constitute the actual base of the Lower Livingston cyclothem. The limestone strata, as well as the shales, are extremely fossiliferous, containing many specimens and probably several species of *Murchisonia, Aviculopecten, Bellerophon,* and species of possible *Worthenia.* It was from some of these strata, also, that Geis obtained fossil Pedicellariae.[12]

Upper Livingston cyclothem.—The chief stratigraphic interest in this cyclothem, probably, is that it contains the prominent limestone member, the "Shoal Creek" and "LaSalle" of authors. It is the uppermost of the Pennsylvanian

[10]Ball, J. R., Some Pennsylvanian limestones of the Carlinville quadrangle, Illinois: Trans. Ill. Acad. Sci., Vol. 26, page 97, 1934.

[11]*Op. cit.*, page 145.

[12]Geis, H. L., Recent and fossil Pedicellariae: Jour. Paleontology, Vol. 10, pp. 439–441; 448; pls. 60, 61, 1936.

strata in the same gully tributary to Macoupin Creek which displays also all the preceding cyclothems, with the exception of the Trivoli. The limestone is the uppermost in the gully exposures farther east and south in the quadrangle as well, and it has been traced beyond the confines of the quadrangle by Wanless, Sidney Ekblaw, and many others.

In several of the drill records of the quadrangle, the thickness of the limestone ranges up to 12 feet and is about the same in the surface exposures. A relatively thick black platy shale underlies the limestone in many of its outcrops. The shale is resistant to weathering and erosion and is responsible for low waterfall ledges. It is nearly 3 feet thick and is fossiliferous, containing pelecypods, fish spines, and scales, and conodonts.

Fossils.—Fossils weather out readily from the Upper Livingston limestone, and large collections have been taken. *Lophophyllum profundum, L. profundum radicostum,* and large species, either *Lophophyllum* or *Campophyllum* ? are abundant. There are numerous plates and ossicles of crinoids, and many brachiopods and gastropods, including *Chonetes granulifer* and *Chonetes* sp., *Marginifera splendens, M. wabashensis, Wellerella tetrahedra, Dielasma bovidens, Neosporifer camcratus, N. triplicatus, Punctospirifer kentuckyensis, Ambocoelia planoconvexa, Composita subtilita, Platyceras trigonalis, Trepospira sphaerulata, Naticopsis ventricosa,* and species compared with *Wellerella osagensis, Cyrtolites ? gillanus, Aclisino condito, A. swallowana,* and recognized *A. stevensana.*

In the thin limestone band horizon of the Lower Livingston cyclothem, *Jonesina arcuata, J. gregaria,* and a species of *Primitia* have been recognized. The list for the Upper Livingston cyclothem is not complete, nor has it been completely checked over, but enough has been cited to show it a very characteristic Pennsylvanian fauna of Illinois.

Divide ? cyclothem.—This probably is but a channel sandstone, so designated by Wanless,[13] as it includes only sandstone and shale. It, or a similar sandstone, cuts through a considerable stratigraphic range if it is the same sandstone which has been observed in several places in this and in quadrangles west and north of the Carlinville. It is observed to have a major thickness of about 10 feet in the quadrangle and, in the field work, was called the "McWain" sandstone because of its several outcrops on the McWain properties along Macoupin Creek.

SUMMARY

Eliminating the "Divide" cyclothem, then, from the list named in this paper, the quadrangle exhibits actually about 100 feet of McLeansboro strata which properly may be included in its cyclothems.

[13] *Op. cit.*, page 812.

INSOLUBLE RESIDUES OF THE LEVIAS AND RENAULT FORMATIONS IN HARDIN COUNTY, ILLINOIS

F. E. Tippie

Illinois State Geological Survey, Urbana

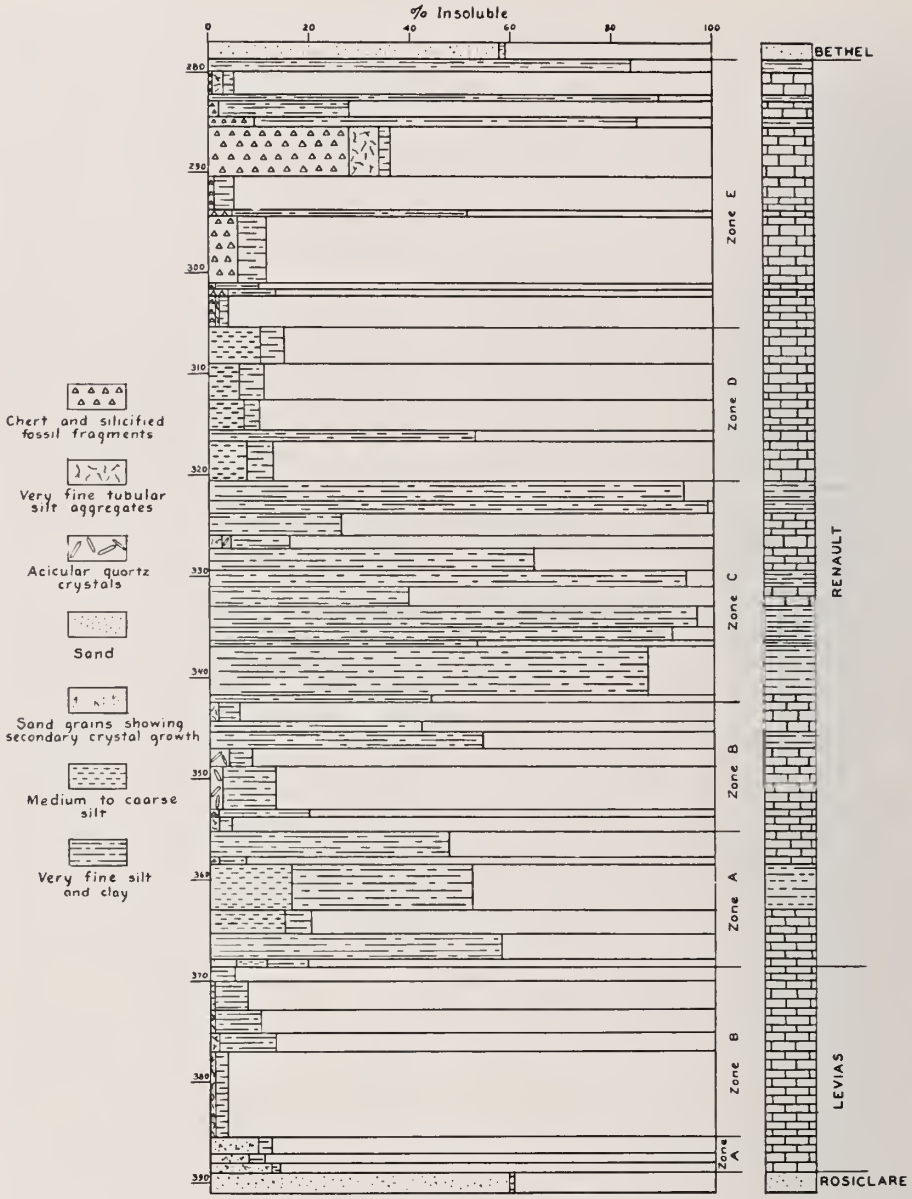
During recent work of the Illinois State Geological Survey in Hardin County, Illinois, it was found desirable to determine zones in the Renault formation and to make more definite separation of the Levias member of the Ste. Geneiveve formation from the overlying Renault formation than has heretofore been possible. Inasmuch as both the Renault and Levias formations are dominantly limestone, the method of study by means of insoluble residues is well suited to the problem. This study is by no means complete, but the data presented in this paper have proved valuable in the work of identifying the stratigraphic positions of limited outcrop sections and diamond-drill cores of these two formations. This in turn assists in the determination of the throw of some normal faults cutting these formations. The general practice in angle-drilling for vein deposits of fluorspar is to drill but a few feet beyond the fault. Rarely is this far enough to penetrate a contact of two formations. Thus by zoning formations one can easily determine the exact throw of the fault.

Samples were obtained both from outcrops and from diamond-drill cores. Two of the sample sets examined were collected from the Cave in Rock fluorspar mining area and the remainder from the Rosiclare area. Samples were taken at every change in lithology unless the lithology was consistent for more than 5 feet. In such cases one sample was taken for every 5 feet. The average sample interval is about 2 feet.

The procedure used was essentially that outlined by L. E. Workman of the Illinois State Geological Survey. A 12-gram sample was dissolved in dilute hydrochloric acid and the coarse and fine residues were separated by decanting. Both fractions were weighed and examined under the microscope. The calculated percentages of insoluble residues were plotted in graphic form (fig. 1) to facilitate the comparison of results from one set of samples with another. The residue graph represents the most complete section available at the present time and is typical of both formations. This graph is based on samples taken from diamond-drill cores of the Rosiclare Lead and Fluorspar Mining Co.—A. C. No. 2 test hole.

The Levias limestone is characterized by relatively little insoluble material, having a maximum of 13 per cent and a minimum of 3 per cent in the sections tested. The average residue content is about 8 per cent. The Levias is subdivided into two zones. The lower zone (A) is characterized by very fine sand grains, showing secondary crystal growth and comprising two to twelve per cent of the rock. These sand grains are probably reworked from the underlying Rosiclare sandstone. Glauconite which also may have been derived from the Rosiclare is present in this zone. The very fine silt and clay fraction is relatively unimportant in this zone and does not exceed 3 per cent of the rock. Zone A is variable in thickness, ranging up to a maximum of 4 feet in the sections studied. The residue graph (fig. 1) exhibits a well developed zone A of Levias.

Zone B of the Levias is characterized by a relatively low average residue content of about seven per cent in the sections studied. The residues are dominantly very fine silt and clay. The coarse fraction, rarely exceeding one per cent of the total rock, is characterized by very fine silt aggregates that are frequently tubular in shape, possibly indicating an organic source. The average thickness of zone B in the sections studied is about 16 feet.



INSOLUBLE RESIDUE GRAPH

ROSICLARE LEAD AND FLUORSPAR MINING CO. - A. C. NO. 2
SEC. 32, T. 12 S., R 8 E., HARDIN COUNTY

ILLINOIS STATE GEOLOGICAL SURVEY

MAY 1, 1943

Fig. 1.

The contact of the Levias and Renault is characterized by an abrupt change in total residue content, the average content of the Renault being about 40 per cent as compared with the average of 8 per cent in the Levias.

The Renault is subdivided into five zones on the basis of insoluble residues. The total residue of zone A at the base covers a wide range from 10 per cent to as high as 58 per cent, the variation being due to the variable proportion of clay material. The coarse residue is characterized by the presence of medium to coarse silt grains, which comprise 5 to 15 per cent of the total rock. The abundance of silt is the distinguishing characteristic of this zone. The average thickness of the zone is about 14 feet.

Zone B of the Renault is characterized by low total residue content except for a few thin beds of shale. The average residue content is about 9 per cent, dominantly clay. The coarse fraction varies from less than 1 up to 4 per cent of the total rock and consists of fine acicular quartz crystals and very fine tubular silt aggregates similar to those in Zone B of the Levias. A 3-foot shale zone near the top seems to be traceable throughout the area. The average thickness of the zone is about 13 feet.

Zone C of the Renault is a very high residue zone consisting of very finely silty calcareous shales and thin beds of argillaceous limestones. The average residue content is about 75 to 80 per cent. A few of the less argillaceous limestones may have minor quantities of very fine silt aggregates typical of the zone below. The average thickness of this zone is about 20 feet.

Zone D has a relatively low residue content, characterized by an abundance of coarse silt and minor amounts of clay and very fine silt. The coarse silt content ranges from 6 to 10 per cent and the fine fraction from 2 to 5 per cent.

Zone E of the Renault is characterized by chert and silicified fossils, particularly crinoid stems. The total residue content varies from 5 to 27 per cent depending on the per cent of chert present. A few calcareous fossiliferous shale beds tend to increase the average residue content of the zone. The chert is white to faintly bluish. Very fine tubular silt aggregates may be present in considerable quantity, but are not persistent. Frequently silicified brachiopods have been noted. The maximum recorded thickness of this zone is about 35 feet.

In some localities the Bethel sandstone rests directly on zones C and D or on an unusually thin section of zone E. This is indicative of the unconformity recognized at the base of the Bethel sandstone.

Conclusions

It is shown herein that on the basis of insoluble residues the Renault can be readily subdivided into five persistent zones. These zones are applicable to the Illinois fluorspar mining area and may be used to establish stratigraphic position within the Levias and Renault limestones. The unconformity at the top of the Renault formation is very well established by the absence of zones D and E in some localities. The low residue content of the Levias offers sufficient data to separate that limestone from the overlying Renault limestone. The presence of sand grains showing secondary crystal growth in the lower Levias is an adequate criterion to separate the Levias and Rosiclare members of the Ste. Genevieve and to indicate that there was at least a limited amount of reworking of Rosiclare sandstone during the early deposition of the Levias limestone.

Acknowledgments

The author is indebted to the fluorspar operators in Illinois for their cooperation in making available for study the diamond-drill cores obtained in prospecting for fluorspar. Special thanks are extended to Mr. P. L. Richards of the Hillside Fluor Spar Mines, Rosiclare, Illinois, who made it possible to do the laboratory work in an assay office of that company, and to Mr. L. E. Workman of the Illinois State Geological Survey for his helpful criticisms.

BEDROCK SURFACE AND THICKNESS OF GLACIAL DRIFT IN WILL COUNTY, ILLINOIS

LELAND HORBERG AND A. C. MASON

Illinois Geological Survey, Urbana

Introduction.—In connection with studies concerned with economic and sanitary problems related to groundwater conditions in Will County, maps of the bedrock surface[2] and the average thickness of glacial drift (fig. 1) in the county have been compiled. Relatively detailed control, based on about 3,000 well records, is available for all of the county except the two eastern tiers of townships. Acknowledgments are due Professor D. J. Fisher and Dr. George H. Otto, who in previous years collected a large number of the well records now available.

Present surface.—The thickness of glacial drift represents the difference between elevations of the present ground surface and of the bedrock surface, which was developed largely by preglacial erosion. The major features of the present surface are the Minooka, Rockdale, and Valparaiso morainic ridges, with intervening ground-moraines, which cross the county in a general northwest-southeast direction. Broad valley-trains along the Kankakee, DesPlaines, and DuPage rivers transect and break the continuity of both end moraines and ground-moraines.

The present ground surface slopes in general away from the Valparaiso and other morainic ridges toward the DesPlaines and Kankakee rivers, which join just beyond the west county-line. The highest point in the county is in T. 36 N., R 11 E., and has an elevation of about 797 feet above sea-level; the lowest is along the west line of the county near the junction of the rivers and has an elevation of about 500 feet. This is a relief of approximately 297 feet in about 20 miles, or slightly greater than the relief of the bedrock surface.

Bedrock surface. — Bedrock elevations within the county range from 720 feet above sea-level on the bedrock upland near Monee (sec. 16, T. 34 N., R. 13 E.) to 455 feet where the DesPlaines bedrock valley leaves the county at the west edge of the map (sec. 18, T. 34 N., R. 9 E.). This is a total maximum relief of 265 feet within a distance of 25 miles. Local relief along the sides of major bedrock valleys is sharp. Slopes of 100 feet in a quarter of a mile are present in the vicinity of Joliet.

The bedrock uplands have low to moderate relief, but in general the bedrock valleys appear to be relatively narrow and steep and would be considered youthful. Some of the larger valleys, however, are wide enough to have reached the stage of early maturity.

There is a general parallelism of bedrock valleys and present valleys with respect to their trends and the major drainage systems represented. In detail, however, the relationship breaks down and there are actually but few cases where present streams have inherited valleys from the bedrock surface.

Most of the bedrock valleys of the county are the eastern headwater portions of River Ticona,[3] a large preglacial stream which flowed westward through Grundy, LaSalle, and Putnam counties to the "Big Bend" of Illinois River. Here it joined the north-south trending bedrock valley of the pre-Wisconsin Mississippi, which is occupied by the present Illinois River below that point. The bedrock divide between the southwestward drainage into River Ticona and the northeastward drainage into the basin of Lake Michigan crosses the eastern part of Will County. This divide was cut through near Lemont to form the Chicago Outlet and also it was breached east of Joliet along a buried bedrock valley.

The preglacial valleys of the county probably developed largely by headward erosion along the west margin of the

[2]For map of the bedrock surface near Joliet see Illinois Geol. Survey Circular 95, 1943. An additional map covering a large part of Will County is to be published later by the Illinois Geol. Survey.

[3]Willman, H. B., Preglacial River Ticona, Ill. Acad. Sci. Trans. Vol. 33, pp. 172–175; Illinois Geol. Survey Circular 68, pp. 9–12, 1940.

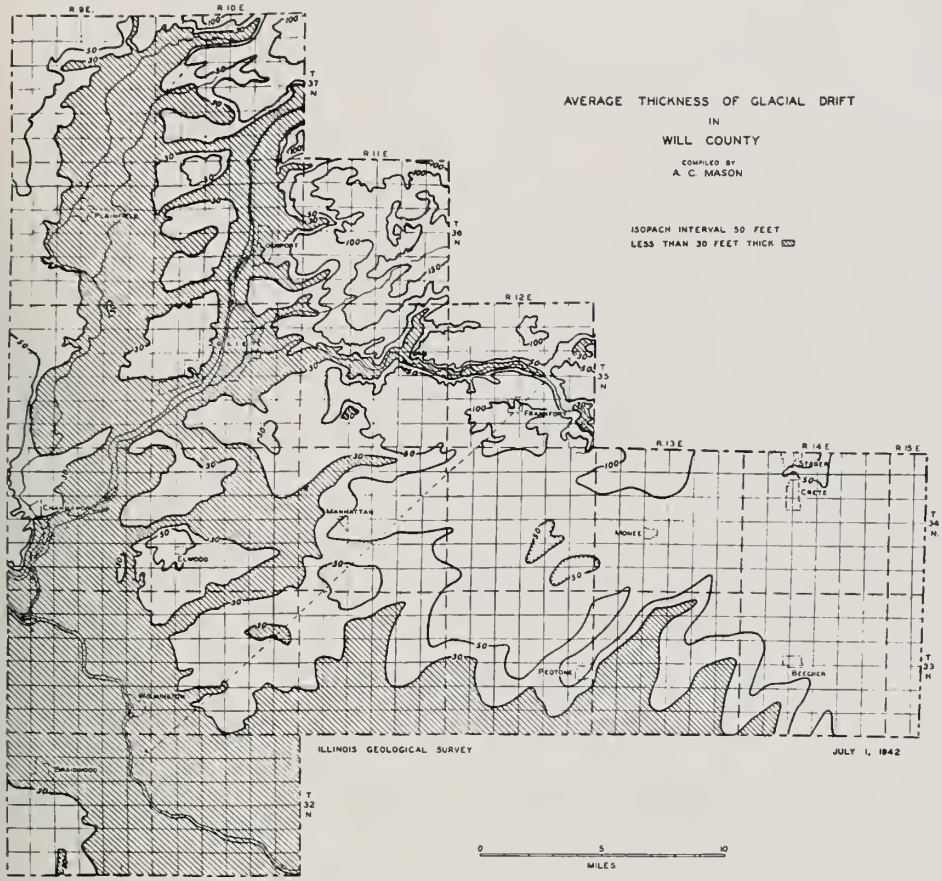


Fig. 1.

Niagaran escarpment which crosses the southwest part of the county. West of the escarpment, bedrock elevations are uniformly lower and reflect a broad lowland eroded on the Maquoketa shale and argillaceous sandstones and shales of the Pennsylvanian system.

Thickness of glacial drift.—Inasmuch as the thickness of the glacial drift (fig. 1) is determined by the difference between elevations of the ground surface and the bedrock surface, the drift is thickest along the undissected portions of the moraines and along buried bedrock valleys. The moraines are of major importance in outlining the three belts of thick drift separated by belts of thin drift, and it is only in the southeast part of T. 36 N., R. 11 E. that bedrock-valley fill is clearly reflected in the thickness map (fig. 1).

The Valparaiso moraine can be traced from the northeast corner of the county (T. 37 N., R. 10 E.) southeastward toward Frankfort and Monee as a belt of thick drift along which the thicknesses range from 50 to over 150 feet. To the west, the Rockdale moraine and associated Manhattan ridge is reflected by a central belt of thick drift extending north-south through R. 10 E. Discontinuous areas along this belt have drift thicknesses of 30 to 50 feet, with occasional small areas of over 50 feet. The Minooka moraine forms the belt of thick drift along the west margin of the county north of Channahon and has drift thicknesses generally between 50 and 100 feet. In the intermorainic areas the drift is

generally less than 30 feet thick. Bedrock crops out almost continuously along DesPlaines and Kankakee rivers, occasionally along DuPage River and other streams, and elsewhere in isolated localities.

The greatest thickness of drift in the county occurs in the east half of T. 36 N., R. 11 E. on the Valparaiso moraine and in the valley of Spring Creek nearby where drift has filled a relatively deep bedrock valley. In approximately 60 per cent of the 844 square miles of area of Will County the drift is more than 30 feet thick, in approximately 35 per cent the drift is more than 50 feet thick, and in only 5 per cent of the county is the thickness more than 100 feet.